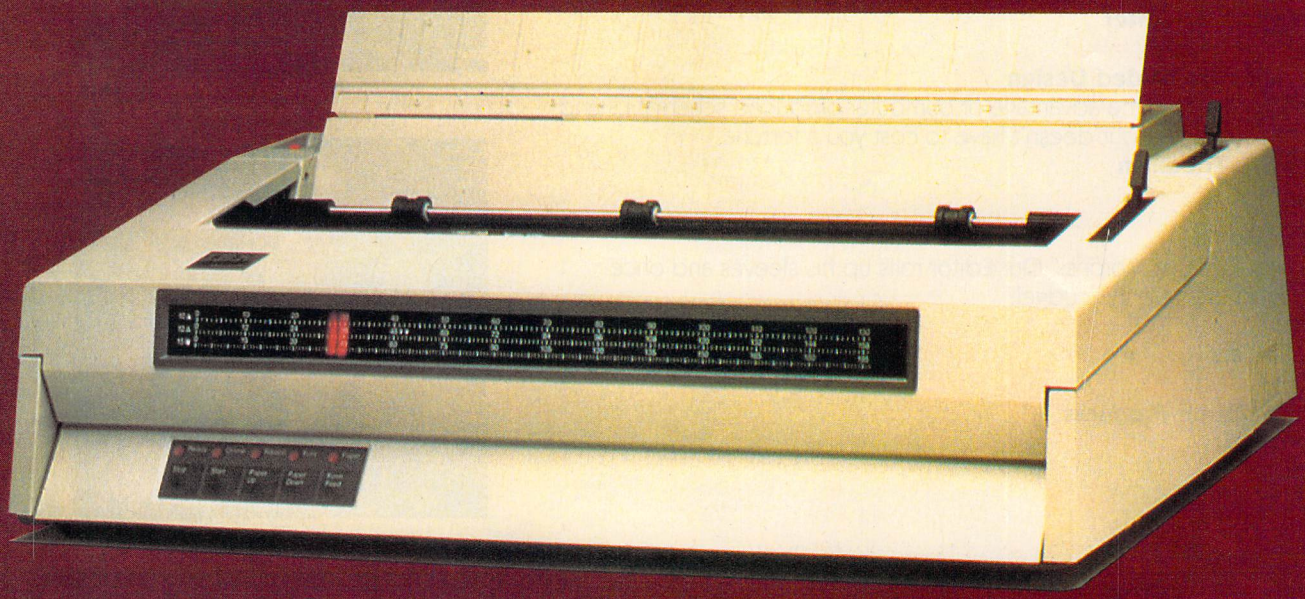
VOL. 2 NO. 10 October 1985

COMPUTER DIGEST

NEW KIND OF MAGAZINE FOR ELECTRONICS PROFESSIONALS

PRINTHEAD TECHNOLOGY

A State-Of-The-Art Report On How They Work.



A GERNSBACK PUBLICATION

SERVING YOUR DELICATE ELECTRONIC EQUIPMENT

Metal oxide varistors can "eat up" those spikes and surges.

COMPUTER AIDED DESIGN

Using your personal computer to generate flow charts and schematic diagrams.

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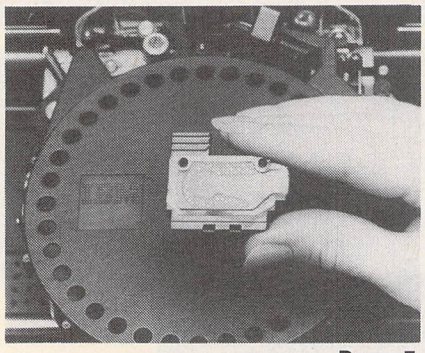

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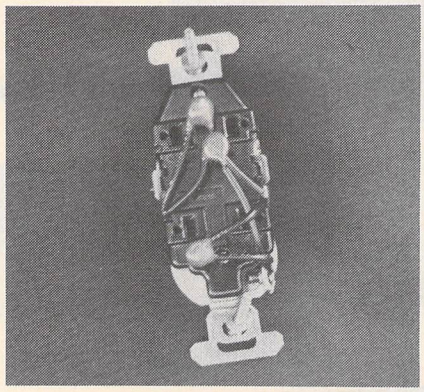

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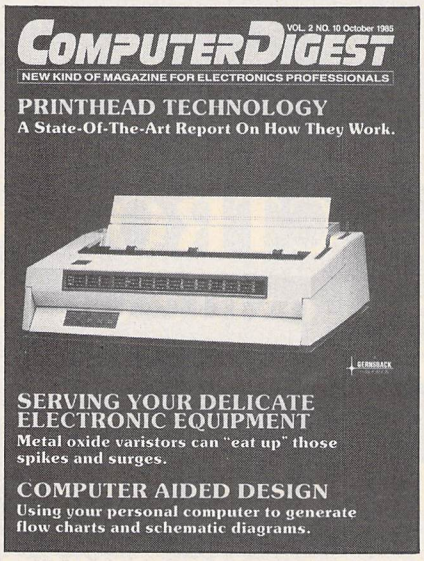
ON THE COVER

The IBM Quietwriter™ printer is typical of modern, up-to-the-minute technology. You can read all about it in the article starting on page 5.



COMING NEXT MONTH

If you've been saving to buy a modem for your Commodore 64, here's the first of a two-part article on how to build one instead.

EDITORIAL

"Hackers are morons..."

■If you want to raise a furor, use the above sentence in the computer community. I did, in my August issue editorial. The mail and telephone calls are *still* coming in. Most of the people that contacted us are involved purely in the semantics. "A hacker," said one, "is an experimenter that 'hacks away' at a computer to make it do something else."

But even this man admitted a distaste for the guy who illegally burrows into another computer system, just to show that he was able to do it! And these very people call themselves hackers!

I have no gripe with the guy who experiments with computers within the confines of his own realm. That's our *reader*! I'm down on the nut that thinks he deserves a medal for having broken into somebody else's computer system and loused things up just to show that he was able to .

And *that's* what's called a "hacker." By the general computing community, and by those morons (see? I said it again!) themselves.

The fact remains that a problem exists. A "hacker" is a thief, a criminal, who uses a computer to break into other computer systems where he has no business. This term is widely accepted throughout the computer industry.

A "computer experimenter" is *not* a hacker. Many of the innovative practices in the computer industry are the result of the work of such experimenters. And from a selfish standpoint, it is the experimenter that **ComputerDigest Magazine** is dedicated to.

Too many "computer experimenters" are fond of denegrating their work and/or hobby by calling themselves "hackers." This is a sad mistake, and I would urge that as a practice, it be halted.

So if you are a computer hacker (in our terms of reference) and that editorial ofended you, I'm certain that this one will prove equally offensive. However, I'd recommend a few courses of action to you:

Give up hacking and get into something a bit more useful—like stealing hubcaps. Do *not* send me any unsigned mail. If you don't have the guts to sign what you write and provide an address to which a reply can be sent, don't write at all.

Just to make the point clearly, for once and all, a "hacker" spends his time trying to break into computers... Government computers, hospital computers, school computers, my computers, etc. and louse up the records. He doesn't do this by any clever, intelligent means, but rather by simple, dogged, repetitive (and very boring) trial and error.

A computer experimenter on the other hand, is an intelligent, thinking individual who tries to improve his own computer or the state of the art technology in general. Whether he succeeds or fails is not important. The fact that he tries puts him in the same category as the great inventors of all time and we all owe him a debt of gratitude. The articles that you see in this magazine were written by computer experimenters.

The hackers contribute nothing to the computer community or the community in general. They give us all a bad name. If they continue to flourish, you're going to see tighter controls on all of us. And Americans, being a freedom-loving people, don't want things like that to happen.

There's a vast difference between the legitimate experimenter and the *illegitimate* hacker!

Or maybe it's just a half-vast difference.

Byron G. Wels

Byron G. Wels
Editor

ComputerDigest is published monthly as an insert in Radio-Electronics magazine by Gernsback Publications, Inc., 200 Park Avenue South, New York, NY 10003. Second-Class Postage Paid at New York, N.Y. and additional mailing offices.

A stamped self-addressed envelope must accompany all submitted manuscripts and/or artwork or photographs if their return is desired should they be rejected. We disclaim any responsibility for the loss or damage of manuscripts and/or artwork or photographs while in our possession or otherwise.

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200 Park Ave. South
New York, NY 10003
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ADVERTISING SALES 212-777-6400
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LETTERS

Complaint!

I enjoyed your Editorial in the March Issue of **ComputerDigest** but if you think Instruction Manuals are bad, you ought to see some of the Service Manuals. It's really sad. It's no wonder people need so much help in getting things to work right. It's not restricted to computers, either. Our shop gets problems on car stereos and answering machines that could be straightened out with some simplified instructions.—P. B. Mann, Atlanta, GA.

Thanks for the comments, P. B. Maybe by calling attention to this much-neglected area of technology, we'll start getting better instruction books from the manufacturers!

New idea.

Liked your Editorial on Computers and the CB Syndrome. But what about including the rising interest in amateur radio and the subsequent decline? I was impressed how amateurs did such a great job of research and development at a low cost.

Also, I've developed a device that will greatly simplify learning electronics, and need professional marketing assistance. How can I get this?—Don L. Harbertson, Morgan, UT.

Don, our prime interest, of course, is computers. We'll leave the amateur radio to those magazines that cater to that field. Of course, I agree wholeheartedly!

Harder and harder

Kids today have it rough. There is so much *more* to learn, yet the time to learn (and teach) has not been extended. Invention is also a closed field, for it takes megabucks to do research which shuts out the individual. It's now a team effort at the Corporate level. What can you recommend for a youngster looking at his future?—Bob J. Seligman, Kent, NH.

Imagination, Bob. There are no dead-end jobs, only dead-end people. You're right about there being more to learn, but education has now become vertically-specialized to compensate for this. And all inventions don't have to be Earth-shattering in scope! There's still room for the individual—Find a new type of cap for a toothpaste tube, or a new kind of paper clip.

Communications trap

Being in the publishing business, of course you're sensitive to communications. I've picked up on your interest in this area in your Editorials, too. But did anything in particular get you hyped on this subject?—Fred Mason, Hackensack, NJ.

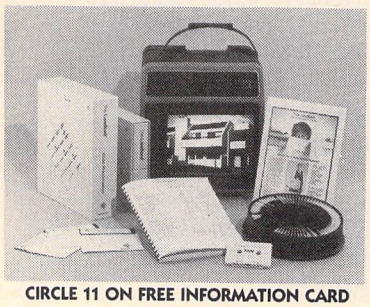
Fred, I was once asked to write a book on "Rock" by a major publisher, and spent the next six months immersing myself in an in-depth study of geology by way of preparation. When I finally delivered the manuscript, I found out that he meant Music!

COMPUTER PRODUCTS

For more details use the free information card inside the back cover

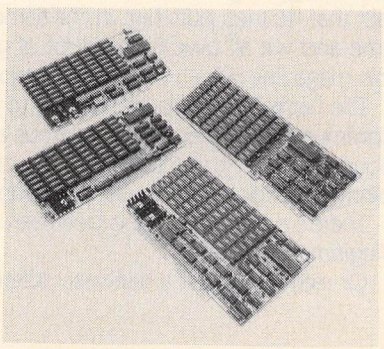
ANALYZER PROGRAM, *The Landlord Investment Analyzer* is designed for real estate investors, who can produce a thorough cost/benefit analysis of properties by using it. It calculates data that is entered for a specific property, including pricing, financing alternatives, expected return, and buyer tax considerations. By objectively comparing investment options, properties that will yield the highest profits are easily identified.

The Landlord Investment Analyzer is completely menu driven, and online instructions provide immediate help. The package is available in PC-DOS, requires 256K memory and one disk drive. It is priced at $350.00.—*Systems Plus, Inc.,* 1120 San Antonio Road, Palo Alto, CA 94303.



CIRCLE 11 ON FREE INFORMATION CARD

EMULATOR, the *SemiDisk,* is a computer peripheral hardware/software disk emulator package that speeds up the operation of computer systems.



CIRCLE 12 ON FREE INFORMATION CARD

SemiDisk is compatible with IBM *PC, XT, AT,* and most IBM PC systems, and the S-100 bus, Epson QX-*10,* and TRS

continued on page 14

PRINTHEAD TECHNOLOGY

Everything you ever wanted to know about printheads.

Marc Stern

■Do you remember the days when the only "serious" computer printers were fully formed character or dot-matrix machines, while thermal printers were given short shrift as "amateur" devices?

Thermal printers are now "serious" machines, whose capabilities rival those of their fully-formed or dot-matrix brethren. In fact, the entire realm of non-impact printers, to which thermal devices belong, has undergone a revolution during the last 18 months. At the start of 1984, laser printers were available at costs exceeding $50,000 and ink-jet printing was confined to commercial ventures. Now, laser imaging printers are available for less than $3,500 and ink-jet printers in the $300 to $1,200 range abound.

Thermal printers

As recently as 1982, thermal printers were looked on as toys. They were among the first personal computer printers, but they had drawbacks. They needed special paper to operate, which tended to discolor rapidly; their resolution was too low for other than rough use, and their print quality wasn't high.

Their technology was a combination of dot-matrix printing and thermal technology.

In use, these printers—most were serial—took the output from a microcomputer and internal microprocessor-based circuitry transformed the output into text. The ASCII codes generated by the microcomputer were compared against character sets stored in Read-Only Memory (ROM) and the appropriate signals were generated for the printhead controller circuitry and printhead, which contained a number of wires. Those wires were fired by tiny solenoids into the special thermal printer paper which was "exposed" by a heater bar over which the paper traveled.

The result was a low-resolution printout of block characters, which was unsuited for any use, other than rough output. The reason for this was the nature of the printhead. It generally contained a matrix of five wires across by seven wires down, which was too coarse for quality text output. Further, the ROM-based character set usually contained only capital letters.

Crucial developments

The change occurred when thermal printing became thermal transfer printing. Instead of relying solely on the heat-sensitive paper to produce printed output,

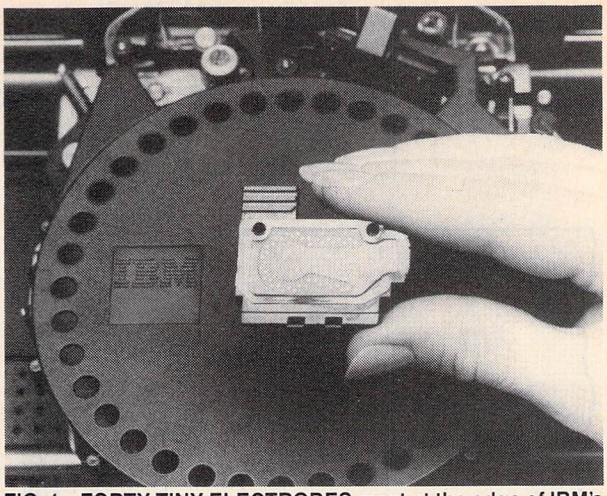


FIG. 1—FORTY TINY ELECTRODES meet at the edge of IBM's electronic printhead. In the background, is the round cassette that holds the IBM "Quiet" (TM) correcting ribbon.

special ribbons were added. The plastic ribbons were struck by the printhead wires as the paper moved over the heater bar and the dot-matrix letters were melted onto the paper. In some cases, not only did the heater bar do the melting, but the printhead wires were also heated to help in the process. In this type of printer, the printhead serves two roles, printhead and heating element.

A second important development came from impact, dot-matrix printer technology.

By using finer printhead wires, more sophisticated internal programming and circuitry, dot-matrix printer manufacturers were able to increase the density of their printheads. The first jump went from 5 by 7 to 7 by 9 or 9 by 9 wires. The increasing number of printhead wires meant letters could now look more normal.

The increase in density continued to the point where denser printheads became common. Densities of 18 to 24 wires or more were usual.

This type of printhead required technological sophistication because each print wire had to be fired at the correct moment and in the correct sequence. Dot-matrix printers had come of age. They were now capable of the precise control needed to generate true descenders and near-letter quality printing.

This technology was transferred to thermal printers, which are non-impact, as opposed to the impact dot-matrix printer (the dot-matrix printer's pins push through a ribbon and then strike the paper) and the result has been a new generation of thermal transfer printers whose output is indistinguishable from a fully formed character machine.

There are two types of thermal transfer technology currently on the market, the older style heater bar or heater head printer and the newer IBM-manufactured thermal transfer printer.

IBM's development is actually a breakthrough in thermal transfer technology. Although many thermal transfer printers can make use of low quality paper and can produce acceptable results, high quality printing still requires special, glossy-style printer paper. With IBM's system, you can use any type of paper.

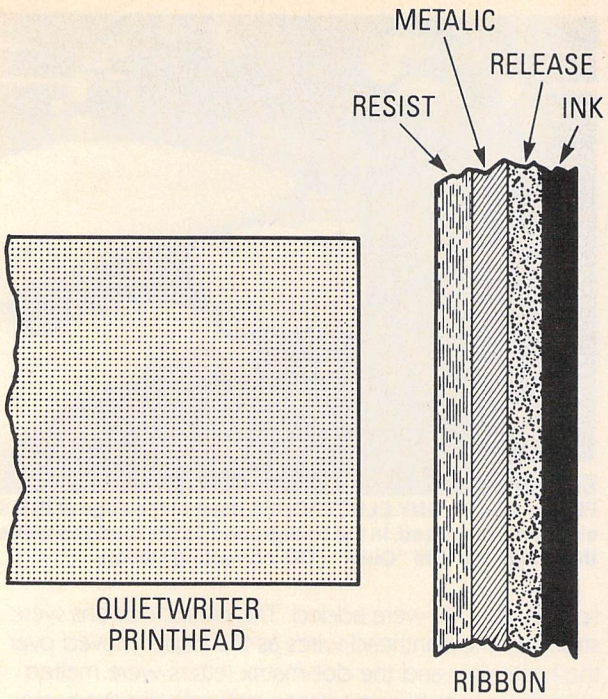


FIG. 2—THE IBM RIBBON uses a four-layer system that works with the printhead to release ink to the paper. The result is an almost-perfectly formed character that is hard to tell from what used to be called "Letter Quality."

Using a 40-wire printhead—See Fig. 1—IBM uses a variation on thermal transfer printing to achieve letter-quality printing from the dot-matrix head.

As in conventional thermal transfer printers, the text is "exposed" by heat, but, with a difference. Where the normal thermal transfer printer passes the paper over a heater bar as the ribbon is being struck by the dot-matrix pins, the IBM system uses a special ribbon that releases ink in response to pinpoints of heat generated by current in the printhead.

IBM's thermal printer uses a four-layer ribbon which consists of a polymer resist material that heats up in pinpointed areas; a metallic conducting layer; an easily meltable layer that permits the release of ink, and a film of ink.

When it is printing a character, the printhead presses the ribbon against the paper and the electrodes contact the resist layer. These electrodes apply small electrical currents that travel through to the metallic layer, with the result that up to 40 pinpoints of heat can be generated. This, in turn, melts tiny areas in the release layer and paints the ink on the paper. (See Fig. 2.)

(IBM also uses this technology on its *Quietwriter* series of electronic typewriters and correcting mistakes by reversing the process to lift letters which have been painted on the paper.)

New typestyles

Like standard dot-matrix printers, the thermal transfer printer is programmable. This programmability, among other things, means it is very easy to change typefaces. By simply inserting a new character-recognition ROM on some of these printers, you can have multiple typefaces. (See Figure 3.) The microprocessor's text-creating algorithm reads the new ROM character set if it sees that the interrupt for the ROM cartridge has been issued. This ROM replaces the printer's standard character set and the new codes are based on it.

Thermal printing has now come of age. Forty-wire printheads and printheads with 36 by 24 resolution are common and, thanks to the special plastic ribbons used, the output looks as if it comes from a fully formed character machine.

Laser imaging

Just a few years ago, laser printers cost the better part of $50,000 and were suitable only for high production atmospheres such as publishing houses or facilities where a great deal of text output was generated. However, the introduction of the Canon laser engine last year changed all that. It has brought laser imaging to market for $3,500 or less.

Capable of running at speeds approaching 8 pages or more a minute, the laser printer makes high speed, high resolution printing and graphics available at an affordable price.

Actually based on office copying technology, the laser printer replaces the document tray and copier cover with a computer interface.

(In today's copier, a bright light illuminates a printed page and a lens captures the image. The image is then digitized and deposited on a drum to which toner is applied. A piece of copier paper is then placed against the drum and an image is made.)

This is very similar to the way in which a laser printer

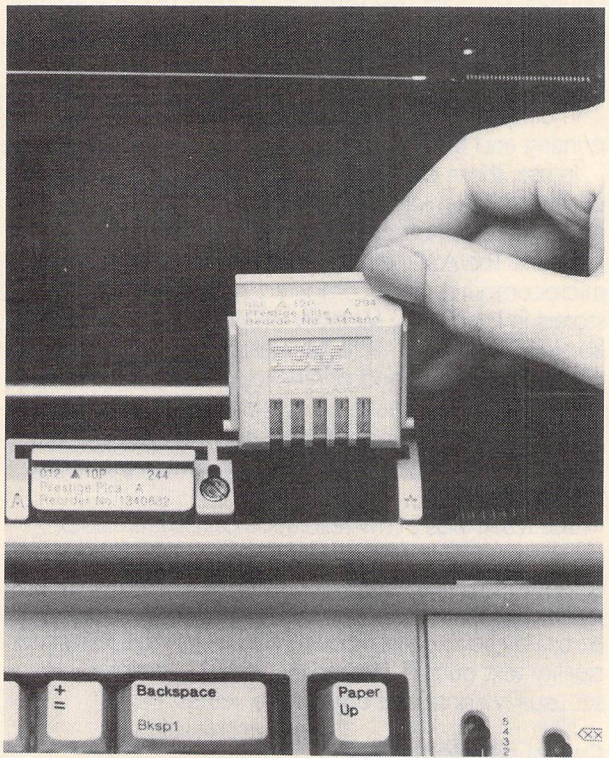


FIG. 3—CHANGING FONTS is as easy as slipping in a cartridge. Two different fonts can be placed in the printer at the same time, and the operator can switch at will from one to the other, simply by programming.

creates its images. However, instead of using a bright light and lens, the computer acts as the front end of the system. ASCII codes generated by a word-processing or text preparation program are sent directly to the laser printer's microprocessor and are stored there until a full page of text is generated.

Each letter passes not only into the printer's storage register, but, as it does, the microprocessor within the unit compares it against whatever special ROM-based character set that may be in use within the printer—italic, gothic, bold, or whatever—as it passes to storage and the text is then stored ready for release to be printed. (Actually, the point where a letter code is compared against ROM depends on where the designer of the algorithm decides to place it. It may be as it passes through the micro or it may wait until the page of text is generated and the whole page is then compared against the character set.)

When the page is released for printing, the micro then directs it to a tiny laser which recreates the text as a series of pinhole bursts of light. Each burst of laser light represents a digital piece of information which goes toward making up the letter.

The laser bursts are, in turn, directed toward a mirror-like drum coated with selenium and the letters are electrostatically etched on the drum. In turn, sooty black toner adheres to areas on the drum that have been charged by the laser and the paper which passes over the drum picks up the toner images.

One of the things you will notice about laser printing, if you look closely at it, is that it looks like a very dense dot-matrix printing. This is because of the bursts of light employed as the laser etches the text. Because of the density of the bursts, the letters look fully formed and are much darker than those produced by a dot-matrix printer.

In general, laser printers not only are microprocessor-driven, but also contain quite a bit of Random-Access Memory (RAM) and ROM. Typeface or graphics information is stored in ROM.

It isn't uncommon to find a laser printer with 64K of RAM and equally as much ROM because of the sophistication of the typefaces available and because of the sophistication of the algorithms.

A graphics-oriented laser printer, on the other hand, can have even more RAM and ROM. As much as 500K of ROM may be used because of the on-board controllers used for graphics work. Apple's *LaserWriter*, for example, contains 500K of ROM and 1.5 megabytes of RAM, as well as an MC-68000 microprocessor. This configuration provides full page graphics.

Non-laser imaging printers

Lasers aren't the only devices used for electronic imaging. Some manufacturers are using liquid crystal lenses and light emitting diode arrays to replace the laser device. For example, Epson's GQ-3000 uses an LCD shutter to create characters and images by allowing light to pass through the display. The image is then printed on the drum. (See Fig. 4.)

An LED array is used in Kentek Information Systems' K-2 copier-printer. The LED array replaces the laser to create the image on the drum. Like the laser, the array creates a pulse of light for each bit of information and a fiber-optic lens focuses the pulses on the drum.

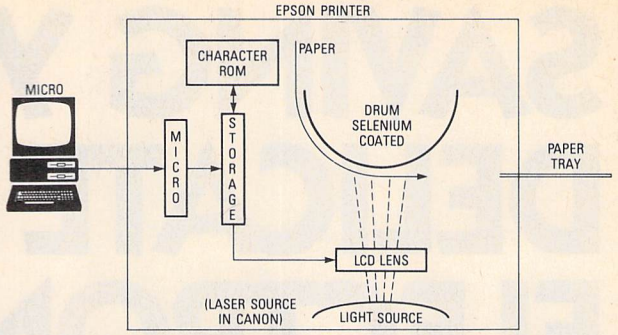


FIG. 4—HOW LASER PRINTING WORKS. Note that in the Canon system, there is no LCD. The system is fast, efficient, and exemplary. See text for fuller explanation.

One other variation, now undergoing testing, is Phillips Peripherals' *Elpho 20*. This device uses a CRT connected to a photocopier mechanism. Using a CRT that is only one line high, a beam of blue light is emitted by the CRT and is focused on a print drum by a lens. Selenium is particularly sensitive to blue light and so it makes sense to use this. The CRT, inside the printer, takes the place of the laser, LCD or LED array.

Ink jets

Available for as little as $495, an ink-jet printer sprays droplets of ink onto a sheet of paper with sufficient force to make it adhere to that paper.

Lower-cost ink-jet printers use "drop-on-demand" technology, where the tiny droplets are ejected from the ink nozzles by a crystal which acts much as the solenoid in a dot-matrix printhead. The rapid action of the piezoelectric crystal in response to current is the factor which enables it to function as the ink pump.

Like dot-matrix printers, the printed output of an ink-jet printer is in a series of dots that resolve into letters. The ink dots correspond to the digital information passed from the printhead controller to the printhead as to the number of dots and their arrangement in making up a letter.

In some ink-jet printers a multijet printhead is used to produce color graphics. These machines have three to seven jets, each of which is connected to an ink reservoir of a different color. The order in which the program tells them to fire determines the coloring of the graphic work. The program orders a specific jet to fire at a specific time.

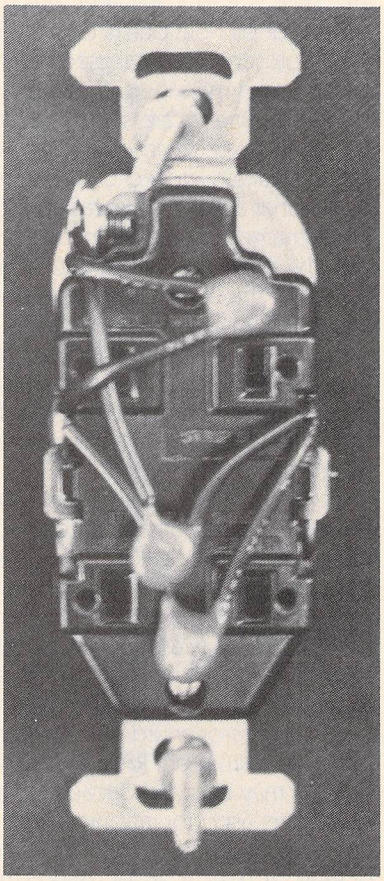
"Drop-on-demand" technology is the least expensive form of ink-jet technology. The second type used is also the most expensive, continuous stream. In this type of printer, an acoustic transducer generates sound waves which deflect droplets of ink onto the paper so they form letters. The stream of ink flows continuously and returns to its reservoir thanks to a low pressure area created in front of the printhead.

Nonimpact printer technology has taken huge strides. Printers that were once considered "toys" are now assuming a serious role. Their output is good and they offer more variety.◀CD▶

SAVING YOUR DELICATE ELECTRONIC EQUIPMENT

How to use MOV's (Metal Oxide Varistors) for surge protection.

ELLIOTT S. KANTER



■A lot of attention has been paid to protecting computers and other electronic equipment against power-line surges. These can be the result of either natural or man-made conditions. Examples of natural surges would be lightning hitting power lines, poles or transformers. The man-made are often the result of switching between power-line feeders or other malfunctions that originate at the source of power generation and distribution.

Regardless of the cause, the results are usually the same. Nominal line voltage (108 to 125 volts) undergoes an abrupt upward swing. Values can reach two or three times normal line voltage. Increased demands of air conditioning, power tools or heating systems cycling on the line can also produce "glitches" with similar results. The incoming line voltage rises and as a result, voltage-sensitive components inside a piece of electronic equipment are subjected to high-voltage spikes.

Let's protect everything

We don't hesitate to protect our computers and related equipment against these surges, but what about television receivers, videocassette players, stereo equipment and other electronic equipment whose value may equal the cost of our computers? We tend to regard these more as fixtures than as voltage-sensitive devices.

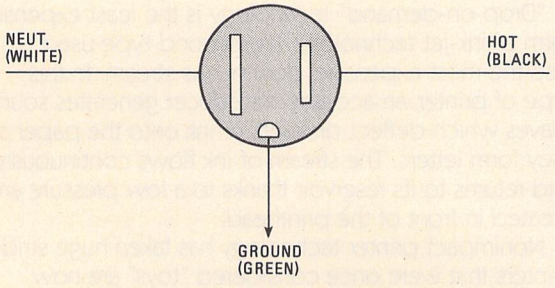


FIG. 1—WIRING FOR THE typical electrical outlet. Note that the outlet shows a polarized plug receptacle.

The typical outlet, shown in Figure 1, consists of three wires. A "hot" wire (black), a "neutral" wire (white) and a "ground" wire (green). When a power surge occurs, it could be impressed on either the black or white lines. The green or ground wire traditionally conducts all stray voltages safely to ground.

Typically, the protective devices we apply to our computers are built into the multi-outlet power strips

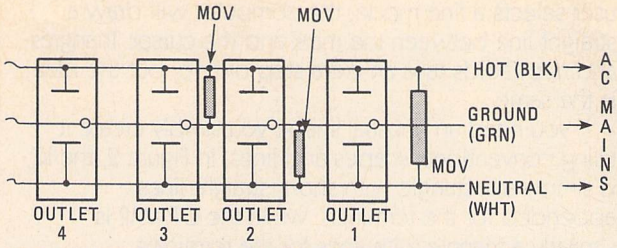


FIG. 2—A TYPICAL MOV-PROTECTED outlet strip. As many additional outlets as needed can be added to the circuit.

and resemble the circuit shown in Figure 2. Each line has what is called a MOV (*Metal Oxide Varistor*) for surge protection. These non-linear devices are voltage-dependent and divert potentially harmful overvoltage conditions. More simply, they "clamp" the voltage and hold it to a safe level.

Building protection

We're going to show how to protect one or two devices, rather than suggest that you buy a multiple outlet strip for surge protection along with filtering that you may not require for your new TV set.

We chose the number "two" because the normal wall outlet in your home is called a "duplex" outlet. There are two identical AC outlets wired in parallel. By protecting one, we also protect the other, giving us an extra benefit at no increase in cost.

Figure 3 shows how to do this. The three MOV

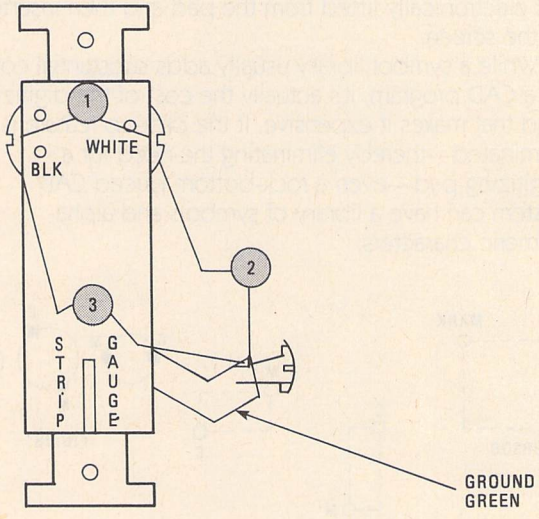


FIG. 3—WIRED RECEPTACLE (rear view) shows how MOV units are placed.

devices required are available from Radio Shack (MOV transient protector Part No. 276-568). They sell in packages for $1.69. You will also need some insulating tubing and some heat-shrinkable tubing.

First identify the fuse or circuit breaker controlling the outlet you plan to modify. To do this, plug a lamp into the outlet and turn the lamp on. Now proceed to unscrew the fuses or turn off the circuit breakers one at a time until the lamp goes out. If you're dealing with fuses, remove the fuse completely. Leave the circuit breaker in the OFF position.

Do **not** attempt to do this work with a "live" circuit!

Remove the screw holding the wall plate. place the screw aside and remove the plate. If it has become stuck in paint, you may have to pry it loose. Place the plate aside with the screw.

You will see two screws, one at the top, one at the bottom. These hold the outlet to the Gem box. Remove these screws and lift the switch out of the box.

Identify the following wires: The BLACK wire, the WHITE wire, the GREEN wire. In older homes, you may find the wire formed into a hook and located under a screw at either side of the outlet. More-modern outlets have the wire end slipped into a hole at the back of the outlet and held in place by screws on the sides. The GREEN or ground connection is usually connected to a single point at one end of the shell.

Loosen the screws as required, and connect one MOV device from the WHITE lead to the BLACK lead. Connect another from the BLACK lead to GROUND, the third MOV goes from the WHITE lead to ground. Examine your work carefully. If there is any exposed wire that might produce a short circuit, especially when the outlet is reinstalled in the gem box, cut a small piece of the insulated tubing and slip it over the exposed leads.

Carefully dress the MOV's against the outlet shell. Replace the outlet into the wall box, replace the upper and lower screws, then position the cover plate and replace the holding screw.

This completes the modification of the outlet for surge and transient protection. Now you can restore the electricity by turning the circuit breaker on or replacing the fuse.

You have provided two outlets with surge and transient protection for a total cost of less than $5.00, with the assurance that these transients and surges can be "clamped" within a stated response time of less than 35 nanoseconds—more than sufficient to save your valuable equipment.

You might wonder why, if surge protection at the individual outlet is such a good idea, we don't simply go to the fuse or circuit-breaker box and place the MOV's right there, and in that way protect all of the outlets in the home? The answer is simple. By doing that, you're fooling with the house's primary wiring, and depending on where you live, might require a building permit to do so. The consequences can be dire. Should you have a fire in your house, this type of do-it-yourself wiring addition can void your insurance.

No, you're better off to restrict yourself to the method we describe here, and add the MOV's—judiciously—at the individual outlets. We say "judiciously," because there's really no requirement to protect some devices against surges. If all you plug into an outlet is a simple lamp, why bother with surge protection? However, should the outlet be used for a TV receiver, stereo equipment, or anything else that might be worth protecting, by all means, this is the way to go.◀Φ▶

COMPUTER AIDED DESIGN

A designer's dream come true.

HERB FRIEDMAN

■CAD, *C*omputer *A*ided *D*esign, covers everything from the complete design of a skyscraper hotel to the schematic for home-brewed electronic projects.

Using a PC

Theoretically, we could use conventional computer graphics to prepare schematics and flow charts, but that's the hard way to do things, for each line, symbol and alphanumeric character would involve a separate construction. We could probably do a lot better—and faster—with a pencil and paper. And even if we *did* the job with conventional computer graphics, a modification to what we create would take longer than redrawing the entire thing with the trusty old paper and pencil!

There are two kinds of low- to moderately-priced CAD programs specifically intended for electronics hobbyists and technicians. The most-common variety, usually priced in the range of $500 to $1000, are descended from conventional mainframe CAD systems and they generate a family of shapes such as rectangles, circles, triangles, trapezoids, etc. that one would normally use to design a building or a car or a kitchen sink. The shapes can be used for creating flow charts and even some electrical circuits.

The shapes are automatically created by the computer between two or three locations that the user pinpoints on the computer screen. Figure 1 shows how a CAD program might automatically create an assortment of shapes. For example Figure 1A shows how a rectangle is created by CAD. Using a joystick, mouse, or just the computer's arrow keys, the user positions the cursor where one corner of the rectangle should be and marks the location with a dot, by pressing the joystick's or mouse's *select* button. Next, the cursor is moved to the opposite corner of the rectangle. As the cursor moves, most CAD programs will create a phantom (flashing) rectangle anchored on the mark and the cursor. When the rectangle is in the desired shape and size, it is locked into position by pressing the *select* button.

The shape constructed on the screen between the mark and cursor depends on the selected mode. As shown in Figure 1B, if the user selects a circle mode, the computer will create a circle using the mark and cursor as the diameter. If, as shown in Figure 1C, the user selects a line mode, the computer will draw a straight line between the mark and the cursor. Triangles and trapezoids take an extra step or two, but the idea is the same.

If you need an unusual shape you simply create it using conventional shapes and lines. In Figure 2, the IC is simply a rectangle with short, straight lines appended for the terminals, while the OPAMP is similarly a triangle with lines for the terminals.

Making it viable

A logical question at this point, is "Since it can take a long time to create the symbol for a 14-point DIP IC what happens if you need 20 or 30 such symbols?" Most of the better quality conventional CAD systems have a *replicate* or *copy* function whereby the user can "pick up" a copy of a symbol by placing the cursor over the symbol and pressing the joystick or mouse-select button. The cursor is then positioned where a copy of the symbol is needed and it is literally dropped into the screen drawing by pressing the select button. The pickup and release can be repeated as often as needed, or the CAD program might require the user to indicate the total number of replications. Because different sizes of the same shapes or symbols are often needed, CAD software generally lets the user zoom in and out on individual symbols for enlargement or reduction during replication.

Just about anything is possible if you're willing to pay for it. For example, the cost of a digitizing pad equipped with a combination light and mechanical pen will buy you a library of *pick up* symbols that can be electronically lifted from the pad and then inserted in the screen.

While a symbol library usually adds substantial cost to a CAD program, it's actually the cost of the digitizing pad that makes it expensive. If the *pick-up* feature is eliminated—thereby eliminating the need for a digitizing pad—even a rock-bottom priced CAD system can have a library of symbols and alpha-numeric characters.

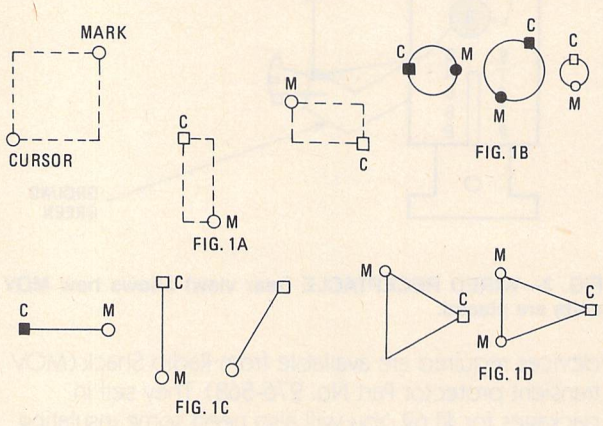


FIG. 1—HIGHER-COST CONVENTIONAL CAD systems automatically generate shapes and symbols between the user-selected marker and the cursor position. The shape automatically adjusts to the distance between the marker and cursor. In 1A, the system is set to generate rectangles. 1B is circles, 1C is straight lines and 1D is triangles.

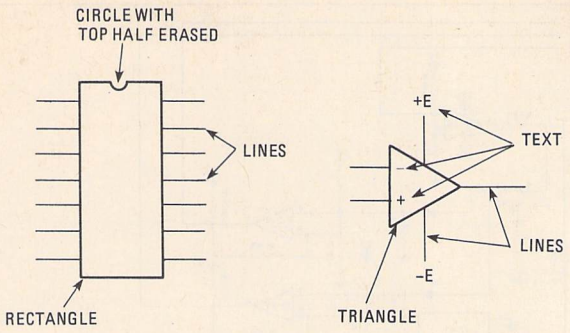


FIG. 2A
IC

FIG. 2B
OPAMP

FIG. 2—COMPONENTS CAN BE CREATED by using the computer's graphics function or by integrating pieces of auto-generated shapes. The IC in 2A started out as a generated rectangle, a circle provided the "notch" and the terminals are conventional lines. The OpAmp in 2B began as a triangle, the connections are lines and the labelling is generated by the CAD TEXT mode.

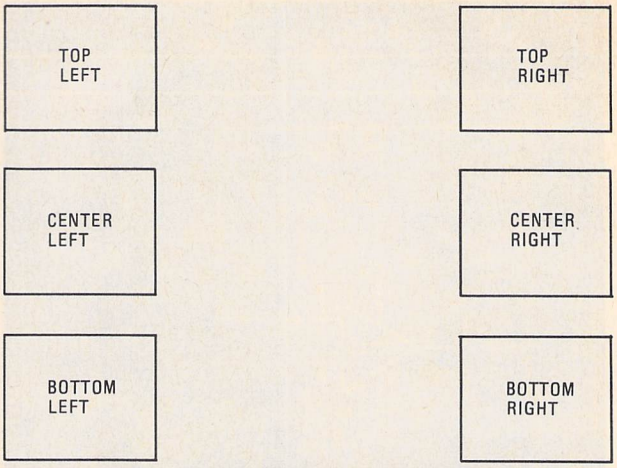


FIG. 4—ACTUAL COMPUTER WORKSPACE is divided into six screens which the printer reassembles. User selects as many screens as needed, decides how they are used.

Since a complete schematic or flow-chart might (and usually does) exceed the capacity of the screen, CAD programs generally permit the user to utilize several screens which are assembled into a unitized drawing when printed. If the number of screens exceed the capacity of the printer, provision is made for the print to be made in sections which can later be taped together.

If all you need is enough CAD power to generate schematics to store on a floppy disk for future review or easy-to-write upgrades and modifications, you can do it on a low-cost home computer using a conventional printer such as the Epson MX-80 (with Graftrax) for the printout. Usually, "drafting" software for home computers is not much better than a child's "computer art" program, but one low-cost program has

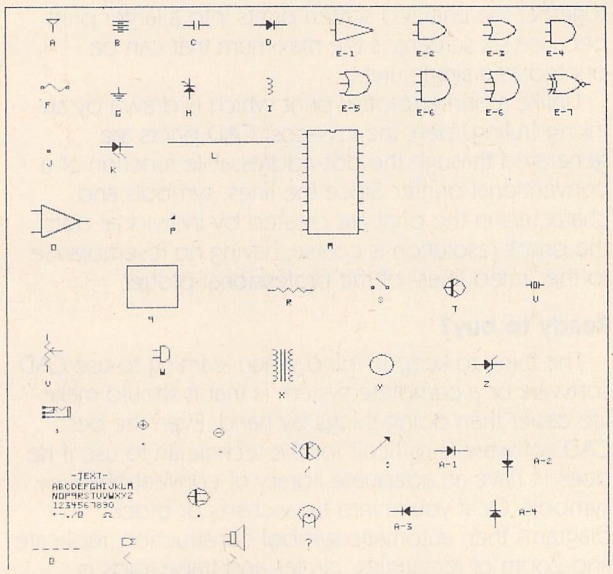


FIG. 3—THE COMPLETE LIBRARY of symbols and text (alphanumeric) for the Drafting Processor. Symbols are inserted at the cursor position pressing the indicated key. A "K" inserts the LED symbol, the "O"inserts an OpAmp, The "B" a battery.

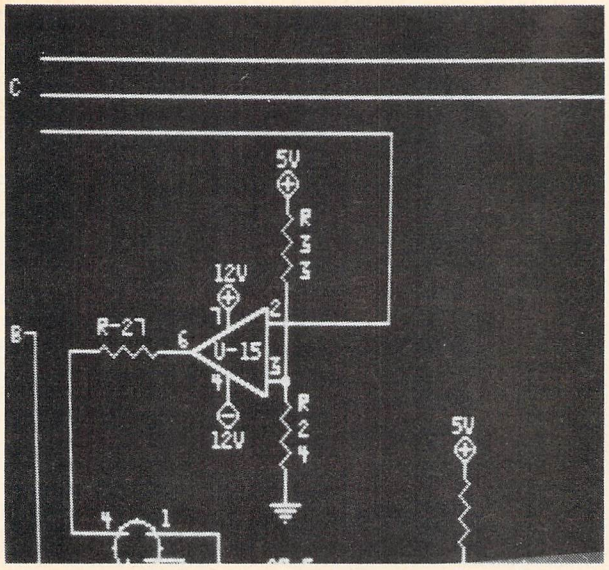
enough "professional" features to enable a home computer to function as a CAD system for electronic technicians and hobbyists. It is in fact, good enough to serve as a trainer for those who want to dip their toes into electronic schematic design.

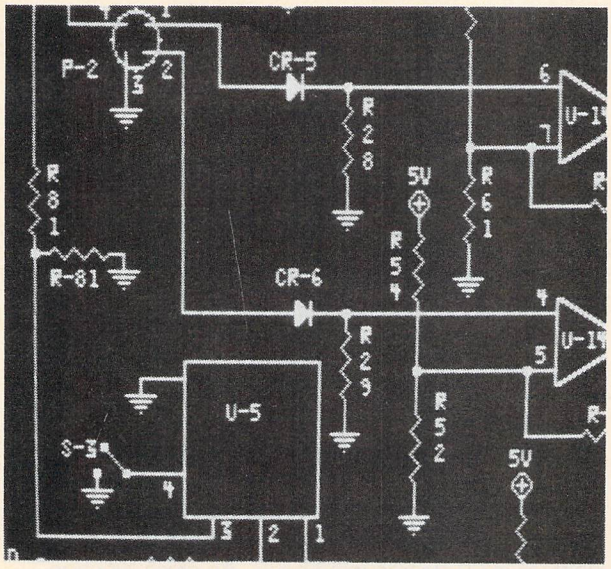
The CAD software is the Schematic Drafting Processor ($49.95, Spectrum Projects, Box 21272, Woodhaven, NY 11421) which requires a 64K Radio Shack Color Computer having at least one disk drive. The program is specifically designed to create electronic schematics primarily through the use of conventional symbols provided in the symbol library shown in Figure 3. Notice that each symbol has an associated keyboard character. Because a light pen isn't supported by the program a library symbol is called up at the cursor position by pressing the key specified for a particular symbol. For example, the "K" key will insert the LED symbol at the cursor. To permit precise positioning, each symbol can be rotated through 360 degrees in 90 degree increments. An erase function permits bits and pieces of library symbols to be pieced together. For example, the top of the circle can be sliced off to generate the half circle needed for the "bottom view" of a transistor. The IC symbol can be sliced, cut through, partially erased or expanded to create any IC package from 4 to 40 pin, or anything else. It takes a lot longer to generate symbols by erase and slice rather than by zoom, but it's a lot less costly.

Also note from Figure 3 that the alphanumerics as well as the omega symbol used to show resistance are also library symbols. When the computer is toggled into the TEXT mode, pressing a key inserts its corresponding alphanumeric character at the cursor position rather than a symbol, permitting you to label the various devices.

In addition to the 30 library symbols provided, the program allows the user to create ten additional symbols through a BASIC program, but doing so requires a considerable degree of programming skill.

Because screen size is limited, as shown in Figure 4, the total workspace is divided into six screens. Each screen display has a slight overlap with adjacent





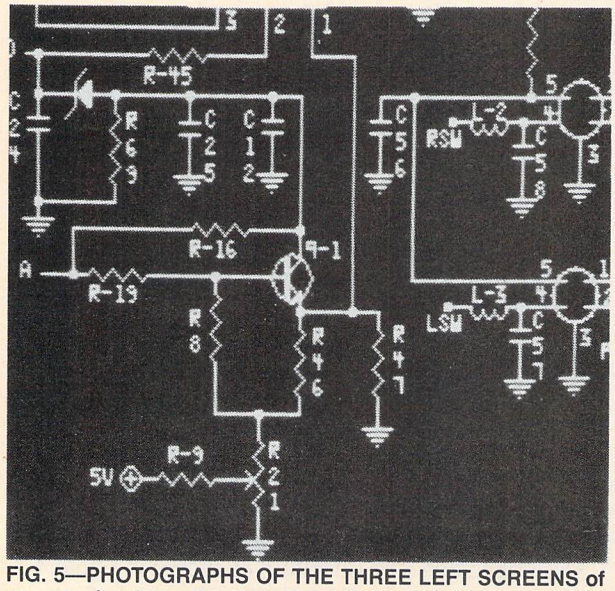


FIG. 5—PHOTOGRAPHS OF THE THREE LEFT SCREENS of an actual schematic. Note the overlap of each screen so drawing continuity can be maintained.

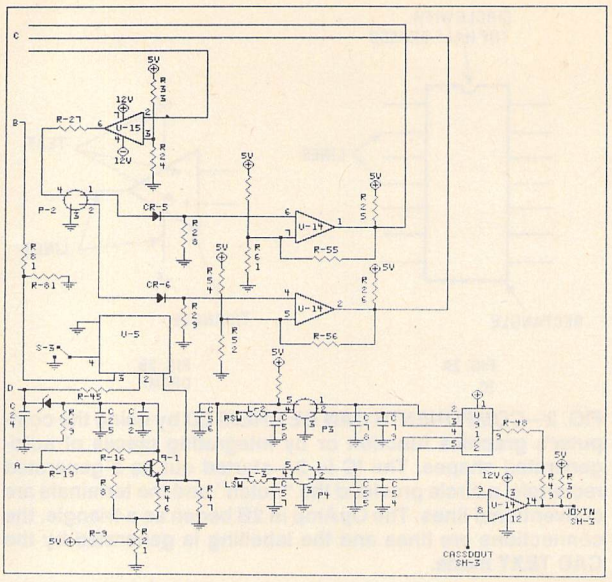


FIG. 6—THE SAMPLE SCHEMATIC—all six screens—as reassembled by a conventional Epson MX-80 dot-matrix printer. Note how components were rotated for proper orientation when inserted into the schematic.

screens so the user can continue registration from previously prepared screens. Like the more expensive CAD systems, all screens are combined into a unit drawing by the printer. Figures 5 and 6 show how this is done. Figures 5*a*, 5*b* and 5*c* are photographs of the actual screen display of the top left, center left and bottom left screens of a schematic that requires all six screens. The overlap area of each screen can easily be seen. Figure 6 is a printout of the entire schematic, all six screens. Note how the three left screens have been precision assembled by the program into the unit print. If the schematic required more area than that allowed by six screens it would have to be created in multiple units of six screens, and it would be necessary to tape together the unitized screen prints into a larger print because six screens is the maximum that can be printed as a single unit.

Unlike a printer/plotter print which is drawn by an inking (ruling) pen, the low-cost CAD prints are generated through the dot-addressable function of a conventional printer. Since the lines, symbols and characters in the print are created by individual dots the print's resolution is coarse, having no resemblance to the "ruled lines" of the professional plotter.

Ready to buy?

The thing to keep in mind when learning to use CAD software or a complete system is that it should make life easier than doing things by hand. Even the best CAD software is difficult for the technician to use if he doesn't have an adequate library of conventional symbols. Or, if you're into flow charts or block diagrams then automatic symbol construction, replicate and zoom of rectangles, circles and trapezoids is considerably more important than a library of symbols. Either way, CAD programs or systems should have features, functions and conveniences specifically intended for the preparation of schematics.◀CD▶

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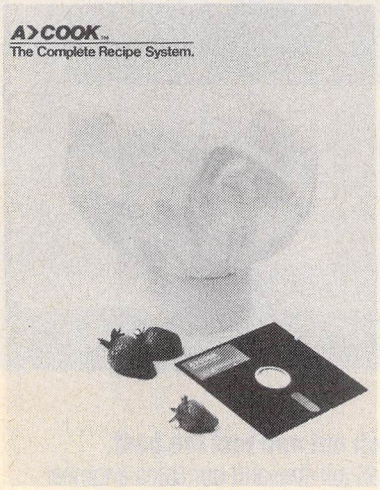
COMPUTER PRODUCTS

continued from page 4

models *II, 12,* and *16.* SemiDisk Systems has developed a new, high-capacity unit that stores up to 2 megabytes of information on a single card. Previously, the largest capacity available on a single card was 1 megabyte.

SemiDisk is priced as follows: 512K capacities: TRS-*80,* S-100, $995.00; QX-*10,* $799.00; IBM *PC, XT, AT* $945.00. Two-megabyte capacities: TRS-*80,* IBM *PC, XT, AT,* QX-*10,* $2499.00. S-100 is $2549.00.—*SemiDisk Systems,* PO Box GG, Beaverton, OR 97075.

COMPUTER RECIPE SYSTEM, *A COOK™,* helps users to locate their own recipes through an easy-to-use indexing system. It allows the user to set up complete recipes of considerable size, and comes with a data base of 500 recipe references from five

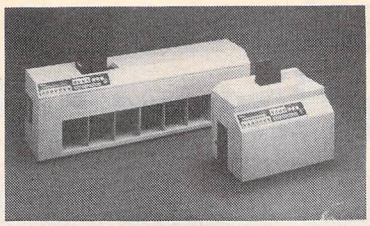


CIRCLE 13 ON FREE INFORMATION CARD

best-selling cookbooks: *Joy of Cooking, M. Heater's New Book of Great Desserts, Mastering the Art of French Cooking Vol. 1, The New James Beard,* and *The New New York Times Cookbook.* The *A COOK™* diskette comes with an instruction booklet, and is priced at $39.95.—*East Hampton Industries, Inc.,* 66 Newtown Lane, East Hampton, NY 11937.

CERTIFIER, the *5000 series,* are microprcessor-based systems that feature Mountain Computer's automatic diskette autoloader and the ability to test high-coercivity media. Certifiers are used by floppy-diskette manufacturers and converters to test media quality, and by end users for incoming quality control.

Four models are available for certifying 3 ½" and 5 ¼" media. The six-bin models simultaneously perform up to



CIRCLE 14 ON FREE INFORMATION CARD

six media quality tests specified by the American National Standards Institute (ANSI): missing bit, extra bit, track average, amplitude, modulation, overwrite, and resolution. The two-bin certifiers perform the same ANSI tests. They are designed primarily for go/no-go incoming inspection of diskettes by large-volume users and original-equipment manufacturers.

The model *5250* six-bin, 5¼" certifier and the model *5253* six-bin 3½" certifier cost $17,915.00. The model *5150* two-bin 5¼" and model *5135* two-bin, 3½" certifier cost $13,995.00.—*Mountain Computer, Inc.,* 300 El Pueblo Road, Scotts Valley, CA.

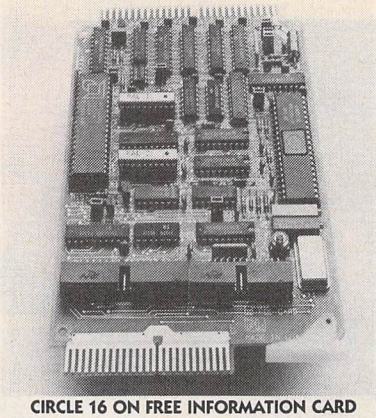
ELECTRONIC TYPEWRITER, the model *ZX-515* can be used independently as a typewriter, or, when interfaced with a computer, as a letter-quality printer; and, connected to an optional disk drive, the 40,000-character memory can be expanded to unlimited off-line storage.

CIRCLE 15 ON FREE INFORMATION CARD

Features of the model *ZX-515* include storage capacity for 26-page formats and 10-column layouts; global search and replace, as well as block move and text linking; four pitch modes: 10, 12, 15, or proportional spacing, and one-touch correction. The model *ZX-515* is priced at $1295.00.—*Sharp Electronics Corporation,* 10 Sharp Plaza, Paramus, NJ 07652.

CONTROLLER CARD, model *7388A,* offers fast memory access and data storage in double-density disk format, while addressing up to 1M of memory for use with 16-bit CPU's.

The model *7388* can interface with 8-bit systems based on Z80, 8085, 6800, and 6809 processors, addressing 64K of memory via DMA and decoding an 8-bit I/O address. The card also supports 8088-based systems with DMA acess to 1M of memory, and the ability to decode up to 10 bits of I/O address. It supports up to four floppy drives in any



CIRCLE 16 ON FREE INFORMATION CARD

format, and comes with a two-year warranty. It is priced at $395.00.—*Pro-Log Corporation,* 2411 Garden Road, Monterey, CA 93940.

PRINTER CONTROL PACKAGE, *Printworks,* lets users of IBM *PC* and compatible systems print wide documents, like spreadsheets, sidewise on standard-width paper. "Pivot Printing", which rotates text 90 degrees to print sidewise on a page, is one of the many features in this printer-control software package. Users are offered easy menu selection of many printer functions, including pitch, mode (boldface, expanded, condensed, etc.,) and font (typeface or style).

CIRCLE 17 ON FREE INFORMATION CARD

Fonts include script, Old English, foreign character sets, the complete IBM character set, and many more. A font editor lets users create additional characters or entire fonts, and even combine or alter existing fonts. *Printworks* is priced at $69.95.—*SoftStyle, Inc.,* 7192 Kalanianole Highway, Suite 205, Honolulu, HI 96825.